

SPECIAL SPECIFICATION

SECTION 16115S

EXTERIOR RACEWAYS, DIRECT BURY CABLES, MANHOLES

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PART 1 - GENERAL

1.01 SCOPE

This specification covers the following items and accessory materials associated with these items: conduits, multiple conduits or duct banks, manholes, and risers. Construction practices during installation of these items are also covered to provide a reliable underground system.

1.02 RELATED SECTIONS

- A. Section 01300 - Submittals
- B. Section 02200 - Earthwork.
- C. Section 02513 - Asphalt Concrete Pavement
- D. Section 03300 - Cast-In-Place Concrete
- E. Section 13085S – Seismic Protection
- F. Section 16120 - Medium Voltage Cable
- G. Section 16320 - Pad Mounted Transformers
- H. Section 16360 - Pad Mounted Switches
- I. Section 16475 - Primary System Safety Requirements

1.03 REFERENCES

The current editions of the referenced standards are a part of this specification.

A. General

- 1. ANSI/NFPA 70 - National Electrical Code.
- 2. ANSI/IEEE C2 - National Electrical Safety Code.
- 3. ASTM C-33 - Standard Specification for Concrete Aggregates.

B. Conduit

1. ANSI C80.1 Rigid Steel Conduit, Zinc Coated.
2. UL 1242 and ANSI C80.6 - Intermediate Metal Conduit.
3. NEMA RN1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
4. NEMA TC2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
5. ANSI/NEMA FB1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Cable Assemblies.
6. NEMA TC3 - PVC Fittings for Use With Rigid PVC Conduit and Tubing.

C. Manholes

1. AASHTO Standard Specification for Highway Bridges.
2. ANSI/ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
3. ANSI/ASTM A569 - Steel, Sheet and Strip, Carbon (0.15 maximum percent), Hot-Rolled, Commercial Quality.
4. ASTM A48 - Gray Iron Castings.
5. STM A123 - Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips.

1.04 SUBMITTALS

The Contractor shall submit catalog data as required per Sandia's Standard Specification, Section 01300.

PART 2 - PRODUCTS

2.01 GENERAL

All materials shall be new and applicable as listed, labeled, or approved by the Underwriters' Laboratories, Inc. Defective equipment or equipment damaged in the course of installation or test shall be replaced or repaired in an approved manner.

2.02 CONDUIT AND DUCT SYSTEMS - GENERAL

Conduit and duct systems shall be of the type specified in the drawings and shall meet the requirements herein.

- A. Conduits shall be joined in such a way as to prevent solid matter from entering the joints. Joints shall form a continuous smooth interior surface between joining conduit sections so that cable will not be damaged when pulled past the joint.
- B. Conduit installed on bridges, building roofs, or high temperature areas shall incorporate expansion joints. Metallic conduit on a bridge shall be grounded.
- C. Pull boxes shall be "FL" style box assemblies of **Fibrelyte composite materials** as manufactured by **Christy Concrete products** or approved equal, **unless other wise noted on drawings**. Material compressive strength shall not be less than 11,000 PSI. Covers shall be **bolt down using penta head bolts**, heavy duty **to meet H20 traffic load and** logo as indicated. Boxes shall be stackable for extra depth. **Dimensions of pull boxes shall be as specified on drawings.**
- D. Communication conduit for fiber optic cable shall have high capacity flexible multiple channel innerduct manufactured by FO-DUCT or as specified on contract drawings. The number of channels shall be specified on the contract drawings.

2.03 METALLIC CONDUIT - GENERAL

- A. All steel conduits , RGS or IMC, in direct contact with the earth shall receive a protective covering which shall be mechanically applied in a factory or field plant especially equipped for this purpose. (Ref. Section 2.07)
- B. No conduit shall be covered with backfill until after the approval of the Sandia Delegated Representative is obtained.

2.04 RIGID METAL CONDUIT AND FITTINGS

- A. Rigid steel conduit: ANSI C80.1.
- B. PVC externally coated conduit: NEMA.RN 1; rigid steel conduit with external 20 mil PVC coating and internal galvanized surface.
- C. Fittings and conduit bodies: ANSI/NEMA FB 1; threaded type, material to match conduit.

2.05 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

- A. Galvanized steel conduit: UL 1242 and ANSI C80.6.
- B. Fittings and conduit bodies: ANSI/NEMA FB 1; use fittings and conduit bodies specified above for rigid steel conduit.

2.06 NON-METALLIC CONDUIT - CONCRETE ENCASED

- A. Conduit: NEMA TC 2; schedule 40 PVC or schedule 80 PVC as indicated on the drawings.
- B. Fittings and conduit bodies: NEMA TC 3.

- C. The concrete for the duct envelope shall conform in quality to all requirements for placing and curing as described in the concrete specifications. No concrete shall be poured until inspection is obtained. Backfilling shall not be started until the concrete has set for 5 hours. No duct shall be covered with backfill until after approval is obtained.
- D. For vertical stub-ups, horizontal bends, and any off-sets greater than 22° in primary electrical and communication underground conduit runs, use PVC-coated rigid steel or IMC factory bends. The minimum radius shall be 24 inches for 3 inches and smaller conduit and 36 inches radius for conduit larger than 3 inches. Half-lapped application of corrosion protection tape is an acceptable alternate to PVC coating. Standard radius conduit can be used for secondary electrical conduit as specified on drawings.

2.07 CORROSION PROTECTION

- A. One of the following methods shall be used for metal conduit below grade:
 - 1. 3M Scotchwrap 51, 20 mils thick used in conjunction with 3M Scotchwrap Pipe Primer applied as recommended by manufacturer.
 - 2. Factory coated PVC on rigid conduit.

2.08 DIRECT BURIED CABLE - GENERAL

- A. Trench shall be opened to specified depth complete length of cable run. Bottom of trench shall be leveled and tamped. Remove obstructions, large rocks, and debris.
- B. Bedding material for cable shall conform to the requirements of ASTM C33 Fine Aggregate and shall be installed to a level uniform depth of 4" in the trench prior to cable installation.

2.09 MANHOLES - GENERAL

- A. Manholes can be either precast concrete or cast-in-place as designated on the drawings.
- B. Drainage shall be provided to keep the manholes free of water during construction.

2.10 MANHOLES - PRECAST CONCRETE

- A. Manufacturer shall have documented experience in the manufacture of manholes for a minimum of three years.
- B. Base course material shall be sand, 3 inches minimum compacted 95%.
- C. Precast concrete: Air-entrained, 4000 psi minimum compressive strength at 28 days.
- D. Reinforcing: AASHTO HS-20; bridge loading.
- E. Manhole Shape: As indicated on drawings.
- F. Inside Dimensions: As indicated on drawings.

- G. Wall Thickness: AASHTO HS-20; bridge loading.
- H. Include 40-inch diameter grooved opening in top section for frame and cover for power manholes and 36-inch diameter grooved opening for communication manholes.
- I. Frame and Cover Sections: 36-inch diameter clear opening for power manholes and 30-inch diameter for communication manholes.
- J. Include one 12-inch drain opening and two 1-inch ground rod openings in base, one each diagonally opposite corners, not less than 6 inches or greater than 12 inches from the wall.
- K. Window for Duct Entry: Unless otherwise specified on drawings, 9-6 inch knockouts 3 rows of three on 8.56 inch centers shall be provided on each wall with top row of knockouts not less than two feet below top of manhole. Reference contract drawings for specific construction details.
- L. Include cable pulling irons opposite each duct entry.
- M. Include inserts for cable racks on three foot centers.
- N. Include metal ladder in manhole, steps at 16 inches on center, ladder bolted to manhole neck.
- O. Ram-Nek, Kent Seal or approved equal sealants shall be used to seal the joints in this manhole.

2.11 MANHOLES - CONCRETE CAST-IN-PLACE

- A. All provisions of Sections 2.10 and 2.12 unless specified in this section.
- B. Concrete: 3000 psi minimum compressive strength at 28 days in conformance with requirements of Section 03300.
- C. Provide reinforcing under the provisions of Section 03300.

2.12 MANHOLE ACCESSORIES

- A. Manhole Frames and Covers: ASTM A48; Class 30B gray cast iron, machine finished with flat bearing surfaces. Covers shall be round and have "Electric" or "Signal" as designated on plans and "SNLA" in permanent lettering.
- B. Sump Covers: ASTM A48; Class 30B gray cast iron.
- C. Pulling Irons: 7/8 inch diameter steel bar forming a triangle of 9 inches per side when set. Galvanize to ANSI/ASTM A153 for irregular shaped articles. Locate opposite each duct entry.
- D. Cable Rack Inserts: Steel channel insert with minimum load rating of 800 pounds, length to match cable rack channel. Locate 3' on center.
- E. Cable Rack Channel: 1-1/2 x 3/4 inch steel channel wall bracket, 48 inch length, with cable rack arm mounting slots on 1-1/2 inch centers.

- F. Cable Racks: ANSI/ASTM A569; steel channel, 1-1/2 x 3/4 x 14 inches with fiberglass reinforced polyester or porcelain cable supports and fastener to match mounting channel.
- G. Manhole Ladder: Cast iron, suitable for manhole shape and construction. Primed and painted light grey.
- H. Waterproofing: Exterior coating of manholes shall be required. The coating shall be a waterproofing type bitumastic or asphaltic material such as Koppers 300M or approved equal.
- I. Ground Rods: 3/4" x 10' Copperweld.
- J. Grade Rings: Pre-cast concrete (4000 psi. minimum compressive strength at 28 days) with inside diameter equivalent to manhole opening specified in Section 2.10H. The ring shall have circumferential rebar #3 minimum with a trowel finish to provide a true plane within 1/8 inch, as determined with a 5-ft straight edge.

PART 3 - EXECUTION

3.01 CONDUITS - GENERAL

- A. The entire trench between terminal points of the conduit run shall be opened before any conduit is laid in order to determine if any obstructions exist. Install duct to locate top of ductbank at depths as indicated on drawings. Any existing utility line crossings are to be as built on drawings showing: type of line, size, and depth below the surface.
- B. Duct banks shall have conduit joints staggered at least six inches, both vertically and horizontally.
- C. Spacers shall be used where more than one duct is installed and shall be the standard product of the duct manufacturer for the type and size duct. They shall be located at five foot intervals, secured to the ducts with #16 gage iron wire. The spacers shall be securely anchored to the bottom of the trench to prevent ducts from floating during concrete pouring. Unless otherwise noted on drawings, 4" conduit shall have an approximately 7.5 inch spacing center-to-center, both horizontally and vertically; 5" conduit shall have an approximate 8.56 inch spacing center-to-center.
- D. Continuous spading during pouring shall be performed to ensure a flow of concrete between and under ducts to eliminate voids. Mechanical vibrators shall not be used.
- E. Terminate conduits in an end bell at manhole and building foundation penetrations. Stub-ups of rigid or IMC duct in equipment pads shall have insulated grounding bushings.
- F. Apply corrosion protection tape, half lapped, to non-PVC-coated underground metallic conduit and fittings that are in direct contact with earth only.
- G. Conduit and duct runs shall be short, straight runs between points of the system. Bends shall be laid out with the greatest possible radius.
- H. Duct runs shall be graded to drain toward one or both terminal points of the duct run. The slope shall not be less than 2 inches for every 100 ft. of length, unless otherwise shown on contract drawings.

- I. Conduits and duct runs shall be installed on compacted soil when entering a manhole, building foundation, crossing a road, railroad track, or bridge abutment to prevent shear stress on the conduit.
- J. All paving and concrete cuts shall be made with a concrete saw. All surfaces to be replaced shall match existing and shall be in accordance with applicable concrete or asphalt specifications.
- K. Conduit penetrations into buildings or through above ground foundations, shall be sealed with duct seal or conduit sealer to prevent gas or water entry.
- L. Trenching and backfilling shall be in accordance with Specification 02200 - Earthwork.
- M. Wires, cables, or other conductors shall be pulled into the duct as shown on the drawings. Empty ducts shall have a 1/4" polypropylene rope provided with 2 feet of slack at each end with both ends secured.
- N. When multiple channel innerducts (FO-DUCT) are pulled through conduit, secure every 10-ft section so as to prevent rolling of channels within conduit. Leave one-foot ends protruding from face of manhole.
- O. Conduit or duct banks shall maintain 1 foot vertical and 1 foot horizontal separation from other utility lines where possible. A separation of 6 feet is desired from steam lines, except at a crossing where power duct shall cross under the steam line with a minimum of 1 foot vertical separation.
- P. A warning tape shall be installed one foot above duct. The warning tape shall be of inert plastic film 4 mils thick specifically formulated for prolonged use underground, resistant to alkalis and acids found in soil. It shall have a tensile strength of 30 pounds per 3 inch wide strip. The tape shall bear a continuous printed message repeated every 36 inches. The tape shall be Terra Tape Standard 250 manufactured by Reef Industries, Inc., or approved equal. The tape shall be colored in accordance with American Public Works Association (APWA) recommended color code for marking buried lines of all types. Current recommended colors are Red for power lines and Orange for telephone/signal.
- Q. Where above grade marking of underground utilities is indicated on drawings, the marking shall be in accordance with Standard Electrical Drawing 92310.
- R. Swab Duct: use suitable caps to protect installed duct against entrance of dirt and moisture.

3.02 CONCRETE ENCASED CONDUITS

- A. Provide minimum **three** inch concrete cover at bottom, **four inch at** top, and **four inch at** sides of conduit or duct bank.
- B. A mandrel 1/4" - 3/8" smaller than the conduit shall be pulled through each conduit. A circular wire brush the same diameter of the conduit shall be pulled through the conduit.
- C. Conduit stub outs shall be RGS or IMC capped and not encased in concrete for future accessibility. Capping shall prevent moisture or debris from entering the duct system.

3.03 DIRECT BURIED CABLE - GENERAL

- A. The cable shall be reeled from the cable reel to trench avoiding dragging it over the surface of the ground. The cable shall not be under tension after installed in the trench.
- B. Bedding material as specified in 2.08B shall be used as backfill to cover the cable a uniform depth of 4".
- C. The remaining trench shall be backfilled screening out sharp rocks and other debris so as to avoid damage to the cable. Backfilling and tamping shall be in accordance with the Specification on Excavation, Fill, Backfill, and Trenching.
- D. A plastic warning tape shall be installed one foot above the cable the complete length of the trench. For power, the tape shall be Red in color with black lettering "Warning Buried Electric Lines" Terra Tape or equivalent. For telephone or signal, the tape shall be Orange in color with black lettering "Warning Buried Signal Lines" Terra Tape or equivalent.

3.04 MANHOLES - PRECAST CONCRETE

- A. Excavate, install base material, and compact base material. Compact to 95% density or as required by manufacturer.
- B. Install, seal, and waterproof precast sections in accordance with manufacturer's instructions.
- C. Use precast grade ring sections to bring manhole entrance to proper elevation.
- D. Install manholes plumb.
- E. Set the top of each manhole to finished elevation.

3.05 MANHOLES - CAST-IN-PLACE CONCRETE

- A. Form cast-in-place manholes, inside and outside surfaces, in accordance with provisions of Section 03300.
- B. Manhole Shape: As indicated on drawings.
- C. Inside Dimensions: As indicated on drawings.
- D. Wall Thickness: As indicated on drawings.
- E. Form window for duct entry as indicated on plans.
- F. Include 12 inch drain opening and two 1-inch ground rod openings in base section.
- G. Cast cable pulling irons in place opposite each duct entry window.
- H. Cast inserts for cable racks in place at three ft. centers.

3.06 MANHOLE ACCESSORIES

- A. Where manhole drainage is into sewers, suitable traps shall be provided to prevent entrance of sewer gas into manholes and duct systems.
- B. Install 2 ground rods with top protruding 4 inches above manhole floor. Connect ground rods with 4/0 bare copper run around perimeter of inside manhole at floor. Copper conductor connection to ground rod to be exothermic.
- C. Waterproof exterior surfaces, joints, and interruptions of manholes after concrete has cured 28 days minimum.
- D. Attach cable racks to inserts after manhole construction is complete.

3.07 MANHOLE AND PULL BOX CONCRETE COLLARS

- A. **Install a one foot wide concrete (3000 psi, 3/4-inch aggregate) collar around the manhole or pull box cover, unless noted otherwise on drawings.**
- B. **As a minimum the height of the concrete collar should go from the top of the manhole or pull box cover to eight inches below grade.**
- C. **The top of the concrete collar shall slope down away from the cover so that no water will accumulate around the cover.**

END OF SECTION